

NSTAR Electric
RELIABILITY CRITERIA

Boston Edison
Commonwealth Electric
Cambridge Electric Light Company

For

TRANSMISSION

SUBSTATION

AND

DISTRIBUTION

FACILITIES

Prepared by: NSTAR System Planning

Planning Criteria

General Comments concerning Document:

1. The **Bold Faced words** are defined in the attached Glossary,
2. The peak loads referred throughout are based on the Company's Load Forecast with Extreme Weather taken into account.
3. The risk based planning criteria employed by the Company utilizes a probability assessment methodology that requires that the Planning, Design, Construction, and Operation of the system be properly evaluated and coordinated to assure compatibility and consistency within the criterion.

TRANSMISSION PLANNING CRITERIA

Bulk transmission system design must be in conformance with at least the NEPOOL and NPCC criteria specified in the NEPOOL Form No. FERC 715 filing. NSTAR companies are members of both NEPOOL and the Northeast Power Coordinating Council (NPCC). In evaluating the adequacy of the transmission system, NSTAR companies use internal planning criteria as well as NEPOOL and NPCC planning criteria. The purpose of the criteria is to assure the highest reliability possible for NSTAR Companies' customers with due regard to economic considerations, operating practices, and system designs.

The NEPOOL criteria are described in the document, "Reliability Standards for the New England Power Pool", revised July 7, 1999. The NPCC criteria are described in NPCC Document A-2, "Basic Criteria for Design and Operation of Interconnected Power Systems", revised August 9, 1995.

The NEPOOL and NPCC documents focus on regional reliability and security. The documents described above specify the types of contingencies to be tested and the required system responses under normal and emergency operating conditions. The goal of these criteria is to ensure the interconnected power system remains secure and reliable. Using these criteria, a disturbance in one portion of the power system does not adversely affect the entire region. NSTAR Companies' Transmission system requirements and Transmission Transfer Capabilities, please refer to NEPOOL Reliability Standards documents described above.

Because the amount of generation located within the high density urban area is significantly less than the annual peak load of that area, NSTAR Companies generally rely on the transmission system to import additional power during peak conditions particularly in Greater Boston area.

The planning criteria under import situation are comprised of two parts. The first part is a starting assumption used to establish a base case situation to which all contingencies are applied for analysis. The second part defines the set of contingencies to be applied under the NSTAR Companies' criteria. Both parts are defined as under:

Starting Assumption

A typical amount of total Megawatts of area generation is removed from the list of units available based on historical experience involving unit unavailability characteristics, before any contingency testing is performed.

After removal of the typical megawatts of unavailable generation, three individual contingency conditions are specified and must be used for testing:

1. Loss of one transmission line or one autotransformer, or
2. Loss of one major generating unit and one autotransformer, or
3. Loss of one major generating unit and one transmission line, or
4. Loss of two transmission elements (lines or autotransformers)

For contingencies identified in items 2 through 4 additional resources that can be brought on to the system within 30 minutes following the loss of the first element are employed to adjust system conditions. For contingencies identified in item 4, loss of small portions of the system are acceptable provided that the reliability of the overall transmission system is not jeopardized.

Criteria Conformance

Following the loss of a major generating unit, equipment loading must be within normal ratings and normally scheduled voltage levels must be maintained.

Following the loss of two major generating units or a unit and a transformer or line, equipment loading levels should be maintained to be within the appropriate emergency rating and voltage levels should be maintained within + or – 10% of normal

SUBSTATION PLANNING CRITERIA

- All **Elements** in service
 - No customer load shall be un-served,
 - Voltages shall be within $\pm 5\%$ of nominal (ANSI A range),
 - No **Element** should exceed its **Normal Rating**
- Loss of an **Element**,
 - Voltages shall be within $\pm 10\%$ of nominal (ANSI B range),
 - Remaining elements shall not exceed their **Emergency Capacity Rating**
 - Switching necessary to transfer load to adjacent supply stations shall be completed so that any affected customers will generally experience no more than a 3 hour loss of service
- If a Substation exceeds its **Load Carrying Capacity** at peak under contingency conditions:
 - Voltages shall be within $\pm 10\%$ of nominal (ANSI B range),
 - Remaining elements shall not exceed their **Emergency Capacity Rating**
 - Transfer capability provided by distribution circuits shall not result in circuit loading beyond their **Emergency Capacity Ratings**
 - For **Low Probability/Low Impact** equipment outages, no more than 25% of a station's peak load should be subject to load shedding and affected customers generally should not experience any more than a 3 hour loss of service during a single load cycle (this shall be applicable only at stations that can implement interruption of loads on a circuit by circuit basis)
 - For load levels above the **Load Carrying Capability** of a station deployment of **Reserve Capacity Capability** shall be made available to facilitate installation of supply capabilities generally within a 24 hour period
 - For **High Probability/High Impact** equipment failures which require extended restoration times, sufficient reserve capacity shall be installed to avoid exceeding the **Load Carrying Capabilities** of the station during any **High Probability/High Impact** equipment outage event with all customer load being served

- No protection system element shall exceed its **Short Circuit Interrupting Rating**
- Substations that cannot meet the above requirements shall be reviewed for supply system mitigation measures sufficient to serve 100% of the projected peak demands under reasonably foreseeable equipment outage conditions. Supply system mitigation measures include but are not limited to the following alternatives:
 - Capacity increases of equipment and facilities through equipment replacement and/or addition of supply system elements
 - Implementation of Demand Side Management programs
 - Implementation of demand reduction or other capacity relief programs that are managed by NSTAR

DISTRIBUTION PLANNING CRITERIA

- All lines in
 - No **Element** shall be loaded beyond its **Normal Rating**
 - Voltages shall be within $\pm 5\%$ of nominal (ANSI A range)
- Loss of an **Element**
 - Load transfers to alternative circuit(s) and circuit sectionalizing shall be employed whenever practical to limit customer service interruption impacts (except for extraordinary events)
 - Remaining elements shall not exceed their **Emergency Capacity Rating**
 - Voltages shall be within $\pm 10\%$ of nominal (ANSI B range)
- When an **Element** reaches its **Emergency Capacity Rating**, under contingency conditions and all customer load cannot be served, where applicable, the following corrective actions will be employed:
 - Customer load would be shed as necessary to maintain equipment loading of all supply system elements to within **Emergency Capacity Rating**
 - Installation of **Reserve Capacity Capability** resources. **Reserve Capacity Capability** resources shall include use of mobile generation or other temporary distribution facility additions
 - Application of **Reserve Capacity Capability** resources shall be employed whenever a significant number of customers experience an interruption that is expected to exceed 3 hours in durations
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- Facility upgrades will be schedule whenever:
 - The above criteria cannot be met
 - There is a high probability of equipment outages
 - Service to customers that would need to be interrupted is of a critical nature
- No protection system elements shall exceed its **Short Circuit Interrupting Rating**.

Appendix A — GLOSSARY

Contingency — An event, usually involving the loss of one or more **Elements**, which interrupts the flow of power on the power system for an extended period of time.

Element — Any electric device with terminals that may be connected to other electric devices, e.g.; a transformer, circuit, circuit breaker, line, or generator.

Emergency — Any abnormal system condition that requires automatic or manual action to prevent or limit the loss of substations, or distribution that could adversely affect the Reliability of the electric system.

Emergency Capacity Rating - The rating based on the operational limit of an **Element** under a set of specified conditions. The conditions take into account the prior and post contingency load levels and load cycle durations for the **Element**, the maintenance history and the calculated capacity that is available in the **Element** based on the life expectancy of the **Element**.

Load Carrying Capacity – The capacity of a Substation based on Firm Capacity plus available transfer switching capacity from adjacent Substations.

Low Probability/Low Impact – Any event that would result in an interruption of service to customers that is considered by the Company to be either unlikely to occur due to the nature, condition and makeup of the equipment providing service to customers or of limited scope in terms of the makeup of customers impacted. For example, loss of a distribution feeder bus in an open air rural substation is considered a low probability event and loss of a small radial section of a distribution line is considered a low impact event.

High Probability/High Impact – Any event that would result in an extended duration interruption of service to customers that is considered by the Company to be a reasonably foreseeable occurrence due to the nature, condition or makeup of the equipment providing service to customers. For example, loss of a single overhead distribution line along a road way is an event that may occur often enough to be considered a more likely occurrence and loss of a transformer at a substation supplying 200 MW of customer load is considered a high impact event.

Normal Rating - The rating that specifies the level of electrical loading, usually expressed in mega-volt amperes (MVA) or other appropriate units that a system,

facility, or **Element** can support or withstand under continuous loading conditions.

Reserve Capacity Capability – The capacity provided through deployment of standby or mobile equipment. This includes on site system generation, spare transformers, mobile transformers, and mobile generators.

Short Circuit Interrupting Rating – The rating of system protection equipment designed to interrupt service under short circuit conditions. The rating is expressed as the amount of short circuit power or current the device can safely interrupt under fault conditions.